The local Distribution and Occurrence of the Fungi of Austin, Texas, and Vicinity

By W. H. Long, Jr.

To understand properly the peculiar fungal distribution and occurrence of this vicinity it is necessary to state briefly the geological conditions and environment.

Austin is located on the Cretaceous, mainly on the Upper Cretaceous, and more specifically on the Austin-Dallas Chalk and Shoal Creek limestone. As the name indicates, this formation is marine and most of it deep-sea deposit.

Our soil is therefore chiefly made from the detritus of these old marine limestone strata. The surface here is very broken, composed of rough, rocky hills with limestone exposed over the greater part of them, with narrow, shallow valleys and arroyos, whose soil has little depth, with here and there an occasional bed of sand and gravel, the remnants of the Tertiary and Quaternary river drift deposits. Austin is situated on the margin of the Edwards Plateau, whose coastward border is the Balcones Escarpment that extends from the northern line of Travis County to the Rio Grande.

The city proper being on the downthrow side of a series of faults that determine this escarpment, is about five hundred feet below the summit of the Edwards Plateau proper, and just east of it and the Colorado River. Practically the same conditions prevail here as on the plateau, viz.: rocky limestone hills, studded with clumps of mountain cedar, barberry, mountain oak, and live oak, none of which make a compact shady forest growth.

While the valleys are sprinkled with a scattering growth of mesquite, and near the edges of the creeks are found elm, hackberry and an occasional cottonwood, near the Colorado River, on the Tertiary and Quaternary gravels, are found clumps of post oaks and black jacks.

Austin is also on the eastern margin of the Lower Sonoran life zone, a zone characterized by a semi-arid xerophytic vegetation, which corresponds well with the geological conditions.

Most fungi, owing to their ephemeral nature, need an abundance of water to make their food supply quickly and sufficiently available; therefore in localities visited by long-continued rains or having an atmosphere laden with moisture, as well as in marshy districts and dark damp forests where evaporation is retarded, fungi are found in great quantities and of many species. On the contrary, when an abundance of water is wanting we may expect to find only a limited number of species.

From the geological and climatic environments that exist, the distribution and occurrence of fungi in this vicinity is found to be limited by three very important factors: (1) The nature of the soil, (2) The paucity of densely wooded areas, especially of large damp forests, and (3) The climatic conditions.

Discussing each of these factors more specifically, we find that the soils in the vicinity of Austin, are formed mainly from limestone detritus and with little vegetable débris in them. The innumerable hillsides and slopes cause much of the surface soil, which contains the vegetable matter, to be washed away, leaving a soil deficient in humus and incapable of nourishing fungi.

The habitat of the majority of our saprophytic fungi is in the valleys and under the trees, especially under the cedars where the débris of leaves, etc., cannot easily be washed away. In some localities clay, gravel or sandy soils are found but these are likewise deficient in organic matter to such an extent that unless sheltered by trees, very few species of fungi are found growing in them. As a rule, then, the soil conditions of this vicinity are unfavorable to fungal growths, except in old pastures where the soil is rich from the droppings of stock. Here we often find fungi in great quantities as regards individuals but usually limited to a few species.

The second condition, lack of deep, dense forests with their ever-present humus in the débris at their roots, excludes a large number of shade-loving species. Our trees, mainly oaks and cedars, are not tall and compact, nor are they sufficiently massed to form dark, damp places, consequently the quantity of humus formed and retained in the soil beneath them is small and not sufficient to encourage or promote the growth of fungi to any great extent.

The third condition, that of climate, is the most potent factor

of the three; it includes the effects of light, heat and moisture, water especially being needed to properly develop the fructification organs of fungi.

Austin is subjected as a rule to sudden and violent variations in temperature, to long periods of exceedingly hot dry weather accompanied by intense sunlight, all of which tax the vitality of the higher green plants much more than that of the fungi. If the quantity of moisture in the air were great it would permit some species to exist here that are otherwise excluded, but the vapor density in this locality is at a minimum.* These climatic forces all operate to deter and limit, or even exclude many species from thriving here that otherwise might be expected. These forces also play an important part in the distribution and number of the parasitic species. The xerophytic character of this region causes a large percentage of the native plants to protect themselves from too much sunlight, heat and evaporation, by clothing their leaves and other green parts with a thick, tough epidermis, with a dense coating of hairs, with stomata so arranged as to remain closed, much of the time, or so sunken beneath the surface as to become inaccessible. The entire plant thus becomes hard, woody and impervious. The spores, therefore, have great difficulty in ever reaching the epidermis as the clothing of long, dense hairs tends to catch and hold them away from the surface. The few that chance to reach the epidermis and germinate are often unable to pierce it with their delicate hyphae and the stomata being closed or inaccessible the germ tubes cannot enter by that route.

The spores, after finding lodgment on the epidermis, often fail to even germinate from lack of sufficient moisture or the intense heat and sunlight may even destroy their vitality. These facts account for the comparative freedom from fungal attacks of most of our oaks, barberry, mesquite, cedar, etc. In the spring when the leaves are young and tender and when moisture is abundant, the fungi may obtain a foothold and often do, or in the summer during protracted rainy periods,† the spores may germinate and often do so,

* The months of July, August, and September during the past season have been a remarkable exception in possessing a high degree of humidity, which has been most evident in foliage and in the development of parasitic fungi.

† As during the past summer.

spreading the fungi rapidly over wide areas. In this manner wheat rust becomes very virulent and destructive.

The majority of the introduced species of the cereals and of other plants are often attacked by the ephemeral fungi, to which they are subjected in their older habitat. Such are the various rusts and smuts infesting wheat, oats, corn, clover. As a rule, the parasitic fungi of this vicinity are very limited in number of species. In this group come two species of *Gymnosporangium G. macropus* on *Juniperus Virginiana*, the other a new form found on mountain cedar, *Sabina sabinoides*, which does not form galls or "apples," but the teleutospore masses break out directly from the stem or leaf in rows, like the teeth of a comb, common during March on the mountain cedar, but never found on *J. Virginiana*. Several species of *Puccinia*, one on *Berberis trifoliata* (barberry), aecidium stage, very rare, stages I, II, III, and spermagonia present, only one infected bush found. A species of *Uromyces* on the mesquite (*Prosopis juliflora*), forms large oblong-cylindric galls or "apples" on the petioles and petiolules, about 2 cm. long by 5 cm. thick, covered with oblong brown sori, which are filled with uredospores; not common, only infesting an occasional tree; II and III stages found on leaves in July, after "apples" have fallen. Another fungus attacks the under side of the mesquite leaves, especially those of the small bushes.

Of the saprophytic fungi we find several well-marked types. Group I, includes those inhabiting various kinds of dung. These are few in number, but have a wide range as to time and place of occurrence, their peculiar habitat producing the environments necessary to a quick growth, therefore on the slightest rain or even dew they send up their organs of reproduction and disseminate their spores. Species of *Ascobolus*, *Lasiobolus*, *Coprinus*, *Psilocybe* and *Stropharia* form some of this group.

In Group II are those growing in the cedar brakes beneath the trees; the cedars especially form at their bases a mass of decaying débris, which persists year after year, and thus attains a thickness of several inches. This being shaded by the overhanging boughs, produces and retains a humus, thereby securing more favorable conditions for fungal growths than in the open, unshaded places. We therefore find quite a diversity of species in such localities.

They form a distinct group, having few or no species in common with the other geographical groups. Several of the Lycoperdales are found here, also a large *Sarcosphaera* with an oil drop in the center of its hyaline spore. In this group comes a *Helvella* with spores like those of *Sarcosphaera;* a large *Morchella* nearly one foot tall, with pileus the color and texture of beeswax; and two species of *Lepiota* with perfectly smooth pilei.

In Group III are those found under the post oaks (*Quercus minor*) and black jacks (*Q. Marilandica*), generally in sandy, gravelly soil, or in the débris of leaves that the winds have collected into heaps, often one foot deep and several yards wide. Here is a totally different fungal vegetation. Not a species has been found in this habitat that is common to the other groups. Here the volvate and annulate species of Agaricales flourish, also several large fleshy species with bright colored pilei. In the leaf débris mentioned, several species of *Boletus* are found. These are all, without exception, Spring fungi.

Group IV includes those growing in grassy places, on lawns, etc., where the ground is frequently watered and the turf permanent. The Phallales are prominent members of this group, especially *Phallus rubicundus*, which was found in several widely separated localities, each time in lawns, open and unshaded. One yard especially had them in great abundance; at least one hundred specimens were collected in various stages of development, from the hyphae just forming a weft, to the mature and deliquescing plant. The parties living at this place said the fungus had appeared in their yard every year during the last ten years. All the specimens were found during April and May; none appeared from May to September, probably because exceedingly hot dry weather has prevailed since then. Two specimens of *Simblum rubescens* were found close together, on a partially shaded lawn; this is much rarer here than *P. rubicundus*, as the two specimens were all that have been found after careful and continued search during the entire spring, which has been exceedingly rainy and wet, and therefore unusually favorable to fungal growths of every description; many fungi have undoubtedly been collected during this season that will probably not be seen again in years.

Group V contains the epixylous species, the wood being in

a more or less rotten condition; these are further limited by the fact that most of the wood here, such as mesquite (*Prosopis*), cedar (*Sabina*) and mountain oak (*Quercus*) do not readily decay; the fungi are thus confined mainly to elm (*Ulmus crassifolia*), cottonwood (*Populus monilifera*), hackberry (*Celtis Mississippiensis*), etc., which do not form a very prominent part of the timber in this vicinity. Polyporaceae are especially common in this group, over twenty species having been found, *Clavaria*, *Coprinus* and *Xerotus* are also represented by several species, one very large club-shaped *Clavaria* being quite conspicuous on old elm stumps. The beautiful geaster-like *Urnula* belongs in this group; it is strictly a Winter species.

Group VI contains those growing in the open rocky or gravelly soils, consisting of few species, usually of Lycoperdales and their allies. These are all strongly xerophytic, mainly terrestrial, the early stages of their existence being passed beneath the soil thus securing better protection. They seem to have adapted themselves better than any of the other fungi to their environments.

Their spores show a special adaptation to xerophytic conditions, being more or less oily, often hyaline and capable of resisting great heat. Being disseminated by the wind they ought to be widely distributed. These characters have been selected by the necessity of existing in this hot dry climate.

The most abundant and widely distributed of this group is a species of *Polysaccum*, which is found in open rocky, gravelly soil or in the mesquite flats. Two rare and unique species closely related to *Gyrophragmium* come in this group; the larger is an annulate species 10–14 cm. tall, with short thick stipe, an agaric-like pileus and lamellae, spores slate-black, ovate-spheroid and wind-disseminated; the other species is much smaller, being only 4–7 cm. tall, with pileus 3 cm. broad, lamellae naked, attached at one end to a central disc and forming a plant somewhat like *Montagnites*, only the lamellae are persistent and dry and the spores wind-disseminated. Both species are evidently connecting links between the Agaricales and Lycoperdales, *Mycenastrum* has two species here, one * with a leathery peridium,

* Found also under elm tree in leaf débris; young stages of the species were found in August at same place.

short thick spiny capillitium and dark brown spherical spores; the other is two inches in diameter with a thick corky peridium and yellow spore mass, the capillitium is longer and more branched.

These species mentioned above indicate a relationship to our Western fungi.

Characteristic representatives of the various groups of fungi as indicated above are as follows:

PARASITIC FUNGI

Gymnosporangium macropus on *Juniperus Virginiana*. March.

Gymnosporangium sp. on *Sabina sabinoides*. March.

Balansia sp. on *Stipa leucotrica*. May.

Puccinia xanthi on *Xanthium strumarium*, III. July–Sept.

Puccinia sp. on *Verbena encelioides*, II. and III. Nov.

Puccinia tanaceti on *Helianthus annuus*, II and III. July.

Puccinia gonolobi on *Gonolobus laevis*, III. July.

Puccinia asparagi on *Asparagus*, III. July.

Puccinia pruni-spinosa, on *Prunus Americana*, II. and III. July.

Puccinia pruni-spinosa on *Prunus Persica*, II. Sept.–Oct.

Puccinia sp. on *Ruellia tuberosa*, II. July–Aug. II. and III. Sept.–Oct.

Puccinia vexans on *Bouteloua racemosa*, II. and III. Sept.–Oct.

Puccinia sp. on *Vernonia altissima* and *V. angustifolia*, II. and III. August.

Puccinia smilacis on *Smilax tamnoides*, II. April–Sept.

Puccinia graminis on wheat and oats, II. and III. June.

Puccinia sp. on *Gaura*, I. and II. March.

Puccinia sp. on *Berberis trifoliata*, I., II., III. March–April.

Puccinia sp. on *Anemone Virginiana*, I., II., III. and *spermagonia*. March–April.

Uromyces trifolii on *Trifolium Carolinianum*, I., II., III. March–May.

Uromyces sp. on *Prosopis juliflora*, II. May–June. II. and III. July–August.

Uromyces euphorbiae on various species of *Euphorbia*, II. and III. July–October.

Uromyces sp. on *Asclepiodora decumbens*, II., III. July.

Uromyces appendiculatus on *Indigofera leptosepala*, II., III July.

Uromyces sp. on an unknown legume, II., III. July.

Uromyces terebrinthi, on *Rhus toxicodendron*, II. July–Aug.

Urómyces spermacoces, on *Diodia teres*, II. and III. Aug.

Accidium xanthoxyli, on *Xanthoxylum clavis-Hercules* var. *fruticosum*.

Accidium euphorbiae on various species of *Euphorbia*. Aug.–Oct.

Accidium dracontium on *Arisaema dracontium*.

Ustilago segetum, on oats and barley. May.

Ustilago utriculosa, on *Polygonum* sp. Oct.

Ustilago sp. on sheaths and leaves of *Boutelona racemosa*. Sept.–Oct.

Ustilago maydis on *Zea Mays*. Sept.

Ustilago sorghi on *Sorghum vulgare*. July.

Ustilago sp. on *Cenchrus tribuloides*. Aug.–Sept.

Tilletia sp. on *Hordeum nodosum*. June.

Uredo fici on *Ficus carica*. Sept.–Oct.

Uredo sp. on *Commelina Virginica*. Oct.

Coleosporium vernoniae on *Vernonia angustifolia*. Aug.

Coleosporium sp. on *Salix nigra*. July.

Coleosporium ipomoeae, on *Ipomoea bona-nox* and *I. purpurea*. Oct.

Albugo amaranthi on *Amaranthus* sp. June–Sept.

Albugo portulacae on *Portulaca oleracea*. Aug.

Albugo ipomoea-pandurata, on various species of *Ipomoea*. July.

Albugo Platensis on *Boerhavia decumbens*. July.

Albugo candida on *Lepidium Virginicum*. Spring.

Peronospora geranii, on *Geranium Carolinianum*. April.

Periconia pycnospora, on *Ligustrum Californicum*. Sept.–Oct.

SAPROPHYTIC FUNGI

Group I. Dung-inhabiting Species

Coprinus, 3 sp.
Lasiobolus, 2 sp.
Humaria, 1 sp.
Peziza (*Tazetta*), 1 sp.
Pilobolus, 1 sp.
Poronia oedipus.
Lachnea, 1 sp.
Cyathus striatus.
Sphaerobolus, 1 sp.
Sordaria, 1 sp.
Mucor, several sp.
Panaeolus, 1 sp.
Psilocybe, 1 sp.
Stropharia, 1 sp.

also two species of Myxomycetes.

Group II. Cedar Brake Fungi

Astraeus, 1 sp.
Tylostoma, 1 sp.
Lycoperdon, 1 sp.
Cantharellus, 2 sp.
Protodermium, 1 sp.
Geaster, 1 sp.
Sarcosphaera, 1 sp.
Morchella, 1 sp.
Helvella, 1 sp.
Lepiota, 3 sp.
Tricholoma, 1 sp.
and many undetermined species of Agaricales.

Group III. Post Oak Land Species

Amanita, 3 sp.
Amanitopsis, 7 sp.
Agaricus; 1 sp.
Lepiota, 3 sp.
Inocybe, 2 sp.
Lactarius, 2 sp.
Russula, several sp.
Hebeloma, several sp.
Boletus, several sp.
Clitocybe.

A large number of species of this group yet await identification.

Group III. Species of grassy Places and Lawns.

Phallus rubicundus.
Phallus impudicus.*
Simblum rubescens.
Clitopilus, 1 sp.
Lepiota, 2 sp.
Polyporus, 1 sp.
and several small species of Agaricales.

Group V. Epixylous Species

Polyporus, 20 sp.
Clavaria, 3 sp.
Coprinus, 3 sp.
Bolbitius, 1 sp.
Schizophyllum, 1 sp.
Lepiota, 1 sp.
Urnula Geaster.
Ascophanus, 1 sp.
Hydnum, 1 sp.
Hebeloma, 1 sp.
Dacryomyces, 1 sp.
Guepinia, 1 sp.
Ulocolla, 2 sp.
Lentinus, 2 sp.
Xerotus, 2 sp.
Lachnea, 1 sp.
Panus, 2 sp.
Sphaerobolus, 1 sp.
Cyathus, 1 sp.
Stemonitis, 2 sp.
Arcyria, 1 sp.

* Local habitat not known definitely.

Group VI. Species of open rocky Soil.

Lycoperdon, several sp.	*Calvatia*, 2 sp.
Bovistella, 1 sp.	*Polysaccum*, 1 sp.
Gyrophragmium (?) 2 sp.	*Mycenastrum*, 2 sp.
Scleroderma, 1 sp.	*Coprinus*, 1 sp.

A complete list and descriptions will be prepared for publication as early as possible. From present indications this new and unworked field will prove exceedingly fruitful in new species and of much interest to mycologists.

UNIVERSITY OF TEXAS, SCHOOL OF BOTANY.